OPERATING SYSTEM (GATE 2023) - REPORTS

Q. 21

Have any Doubt ?

Consider a system with a 40 bit logical address space and 4 KB page size. System uses 4 GB byteaddressable physical memory. Let *n* and *m* are number of page table entries if system uses conventional single-level page table and inverted page table respectively.
The value of $\log_2(n) - \log_2(m)$ is _______.

8 — Your answer is Correct8

Solution :
8

Single-level paging:

$$\text{Number of entries } (n) = \text{Number of logical pages} = \frac{\text{Logical space size}}{\text{Page size}} = \frac{2^{40}}{2^{12}} = 2^{28}$$

Inverted page table:

$$\text{Number of entries } (m) = \text{Number of frames} = \frac{\text{Physical space size}}{\text{Page size}} = \frac{2^{32}}{2^{12}} = 2^{20}$$

$$\log_2(n) - \log_2(m) = \log_2(2^{28}) - \log_2(2^{20}) = 28 - 20 = 8$$

QUESTION ANALYTICS +

Q. 22

Have any Doubt ?

Consider the following C program is executed on a UNIX/Linux system:

```
#include <stdio.h>
#include <unistd.h>
#include <sys/types.h>
#include <sys/wait.h>
int V1 = 10;
int main( )
{
    int V2 = 20;
    pid_t pid;
    pid = fork( );
    if (pid == 0) {
        V1 += 5;
        printf("%d %d ", V1, V2);
        return 0;
    }
    else if (pid > 0) {
        V2 += 5;
        wait (NULL);
        printf("%d %d", V1, V2);
        return 0;
    }
}
```

Assume fork( ) system call in above code do not return error (i.e. it creates a child). What is the output of above program on execution?

A 15 20 10 25 — Correct Option

Solution :
(a)

Child and parent process have their own copy of stack, heap, global variable, local variable, etc. So, change in an own variable does not reflect in other process (i.e. change made by child will not reflect in parent and vice-versa).

Steps:

(i) On process creation, parent and child have now own copy of $V1$, $V2$ with values $V1 = 10$, $V2 = 20$.

(ii) Parent have wait( ), so child will print first.

(iii) In child,
$V1$ += 5, so $V1 = 15$, $V2 = 20$
So child print "15 20"

(iv) In parent
$V2$ += 5, so $V2 = 25$, $V1 = 10$
So parent print "10 25"

B 15 20 15 25

C 15 25 15 25

D Any one of the above can be the output at a time — Your answer is **IN-CORRECT**

QUESTION ANALYTICS +

Q. 23 Have any Doubt ?

Consider a multi-threaded process P with two different threads t_1 and t_2. P uses pure user-level thread. Currently, P is in running state and user thread-library doing thread-switching from t_1 and t_2. Assume CPU-schedular uses Round-Robin (RR) scheduling. At this instance of threadswitching,
the time slice of P has finished. So, operating system (schedular) need to take control. Operating system interrupt process P for process-switching. Which of the following is possible outcome of above situation?

A User thread-library first complete the thread-switching then transfer control to operating system (OS).

B User thread-library abort the thread-switching, then transfer control to OS.

C Immediately the control transferred to OS and interrupted process P remain in user threadlibrary. — Correct Option

Solution :
(c)
Process P using pure user-level thread. So, Kernel do not aware of these thread. Kernel will immediately stop P and schedular start their context-switching.
Meanwhile process P remain in user thread-library. When process P again get running state, it start from where it left, that is user thread-library. And complete the thread-switching.

D None of the above

QUESTION ANALYTICS +

Q. 24 Have any Doubt ?

Consider the processes with arrival time (in ms) and CPU burst time (in ms) in following table:

Process	Arrival Time (ms)	Burst Time (ms)
P_1	0	6
P_2	4	4
P_3	2	9
P_4	5	5

CPU schedular uses Round-Robin scheduling with time quantum of 3 ms. Which of the following is/are correct for schedule of above processes?

A Average turn around time is 15.5 ms. — Your option is **Correct**

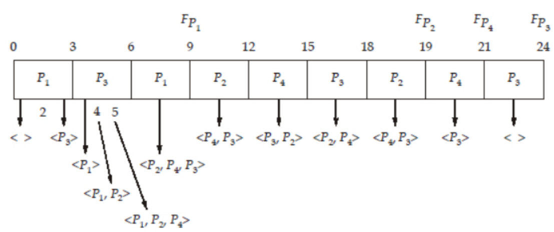
B P_3 terminate before P_4.

C P_2 terminate before P_3. — Your option is **Correct**

D P_2 first time schedule for CPU at 6 ms.

YOUR ANSWER - a,c | CORRECT ANSWER - a,c | STATUS - ✔

Solution :
(a, c)
Use queue for Round-Robin
Gantt chart for schedule



Turn around time (TT) = Finish time − Arrival time

$TT(P_1) = 9 - 0 = 9$

TT (P) = 19 − 4 = 15

$$TT\ (P_3) = 24 - 2 = 22$$
$$TT\ (P_4) = 21 - 5 = 16$$
$$\text{Average turn around time} = \frac{9 + 15 + 22 + 16}{4} = \frac{62}{4} = 15.5$$
Order of termination $\Rightarrow P_1, P_2, P_4, P_3$

P_2 first time schedule for CPU at 9 ms.

QUESTION ANALYTICS +

Q. 25

Have any Doubt ?

Consider a system allocate fixed four frames to a process P. Process P references following pages in given sequence:
1, 5, 3, 8, 3, 6, 5, 1, 7, 8, 3, 5, 1, 3, 5
Let n and m are number of page faults occurs for First-In-First-Out (FIFO) and Least-Recently- Used (LRU) page replacement policies respectively used by system on execution of P as shown above. The value of $n + m$ is _______. (Initially frames are empty)

20 — Your answer is **Correct**20

Solution :
20

FIFO:

1	5	3	8	3	6	5	1	7	8	3	5	1	3	5
			8	8	6	6	1	7	7	3	3	3	3	3
		3	3	3	8	8	6	1	1	7	7	7	7	7
	5	5	5	5	3	3	8	6	6	1	1	1	1	1
1	1	1	1	$\cancel{1}$	5	$\cancel{5}$	$\cancel{3}$	8	$\cancel{8}$	$\cancel{6}$	5	5	5	5
F	F	F	F		F		F	F		F	F			

Number of page faults (n) = 9

LRU:

1	5	3	8	3	6	5	1	7	8	3	5	1	3	5
			8	3	6	5	1	7	8	3	5	1	3	5
		3	3	8	3	6	5	1	7	8	3	5	1	3
	5	5	5	5	8	3	6	5	1	7	8	3	5	1
1	1	1	1	$\cancel{1}$	5	$\cancel{8}$	$\cancel{3}$	$\cancel{6}$	$\cancel{5}$	$\cancel{1}$	$\cancel{7}$	8	8	8
F	F	F	F		F		F	F	F	F	F	F		

$m = 11$ $\quad n + m = 9 + 11 = 20$

QUESTION ANALYTICS +

Q. 26

Have any Doubt ?

Which of the following is correct?

A. In acyclic-graph directory, a file can have two different relative path name, but not two different absolute path name.

B. A dangling pointer possible for a file in tree-structured directories. — Your answer is **IN-CORRECT**

C. If Access Control List (ACL) used to protect a directory, then size of a directory entry (with attributes) will be variable. — Correct Option

Solution :
(c)

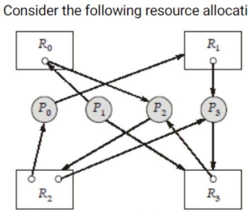
D. None of the above

QUESTION ANALYTICS +

Q. 27

Have any Doubt ?

Consider the following resource allocation graph of a system with P_0, P_1, P_2 and P_3 processes, and R_0, R_1, R_2 and R_3 resources.



Small circle in rectangle shows instance of that resource. So, R_0, R_1 and R_3 have single instances and R_2 has two instances. Consider the following statements for above resource allocation graph of system:
S_1 : System is in deadlock.
S_2 : Cycle in resource allocation graph is sufficient to detect deadlock in system with multiple instance for resources.

S_3 : If any process from above system is aborted/terminated and release its allocated resources, then system will be free from deadlock.
Which of above statements is/are correct?

A S_1 only — Correct Option

Solution :
(a)
Cycle is necessary, but not sufficient condition for deadlock in multi-instance resource system. In above graph, no process able to complete its execution without its required resource. So, it is in deadlock. If P_1 is aborted, then system will remain in deadlock state. Because, it does not hold any resource. If any process other than P_1 get aborted then system will be deadlock free.

B S_1 and S_3 only — Your answer is **IN-CORRECT**

C S_2 and S_3 only

D S_1, S_2 and S_3

QUESTION ANALYTICS +

Q. 28

Have any Doubt ?

Which of the following is incorrect for space allocation method used in disk?

A Linked allocation method is free from external fragmentation.

B Linked allocation method supports direct access. — Your answer is **Correct**

Solution :
(b)
Linked allocation support sequential access of a block in a file.

C Indexed allocation method is free from external fragmentation.

D The pointer overhead of index block in indexed allocation is generally greater than the pointer overhead of linked allocation.

QUESTION ANALYTICS +

Q. 29

Have any Doubt ?

Consider processes with arrival time and CPU burst time in following table:

Process	Arrival Time (ms)	Burst Time (ms)
P_1	0	6
P_2	2	2
P_3	6	1
P_4	3	6

CPU scheduling uses Shortest-Remaining-Rime-First (SRTF) scheduling algorithm to schedule above process. Average context-switch time is 0.7 ms. Do not consider context-switch before start of first process from schedule of above process, if any, and context-switch after completion of last process from schedule of above processes, if any. The CPU utilization for scheduling of above processes is _______ %. (Upto one decimal places)

81.1 [81.0 - 81.1] — Correct Option

Solution :
81.1 [81.0 - 81.1]
Gantt chart for schedule:
CS - Context switch

0–2	2–2.7	2.7–4.7	4.7–5.4	5.4–6	6–6.7	6.7–7.7	7.7–8.4	8.4–11.8
P_1	CS	P_2	CS	P_1	CS	P_3	CS	P_1

11.8–12.5	12.5–18.5
CS	P_1

$$\text{CPU utilization} = \frac{\text{CPU busy time}}{\text{Total time}} \times 100$$

$$= 100 \times \frac{\text{Burst time of all processes}}{\text{Total time}}$$

$$= \frac{15}{18.5} \times 100 = 81.1\%$$

Your Answer is 72

QUESTION ANALYTICS +

Q. 30

Have any Doubt ?

Consider the disk access requests of from <request id, cylinder number> with arrival time in following table:

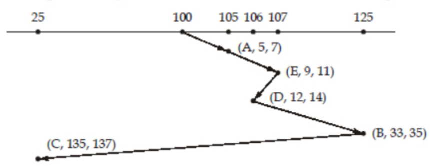
Request id	Cylinder number	Arrival time (milliseconds)
A	105	0
B	125	4
C	25	12
D	106	9
E	107	6

Disk has 200 cylinders (0 – 199) and disk head positioned at cylinder 100 at 0 ms (initial instance).
Disk schedular uses shortest_seek_time_first algorithm and it takes negligible time to perform and schedule a request from queue.
Assume, initially (before arrival of request A) queue is empty. Assume, every request takes 2 ms to transfer data after reaching required cylinder. Schedular perform algorithm only when queue is not empty and after the data transferred for scheduled request, if any. Head movement from a cylinder to its adjacent cylinder takes 1 ms.
Which of the following is incorrect for above requests?

A Disk takes 137 ms to serve all given requests (with data transfer time).

B Request D scheduled after B. Your answer is Correct

Solution :
(b)
Diagram format: <request id, cylinder reach time, data transfer completion time>



Time line functions, queue as

ms	
0	<A>, Algorithm, head = 100
4	<B>,
5	<B>, head = 105
6	<B, E>,
7	<B, E>, A complete, Algorithm for this queue
9	<B, D>, head = 107
11	<B, D>, E complete, Algorithm
12	<B, C>, head = 106
14	<B, C>, D complete, Algorithm
33	<C>, head = 125
35	<C>, B complete, Algorithm
135	< >, head = 25
137	< >, C complete

C Data transfer for request D completed at 14 ms.

D Disk head reaches cylinder 105 at 5 ms.

QUESTION ANALYTICS +